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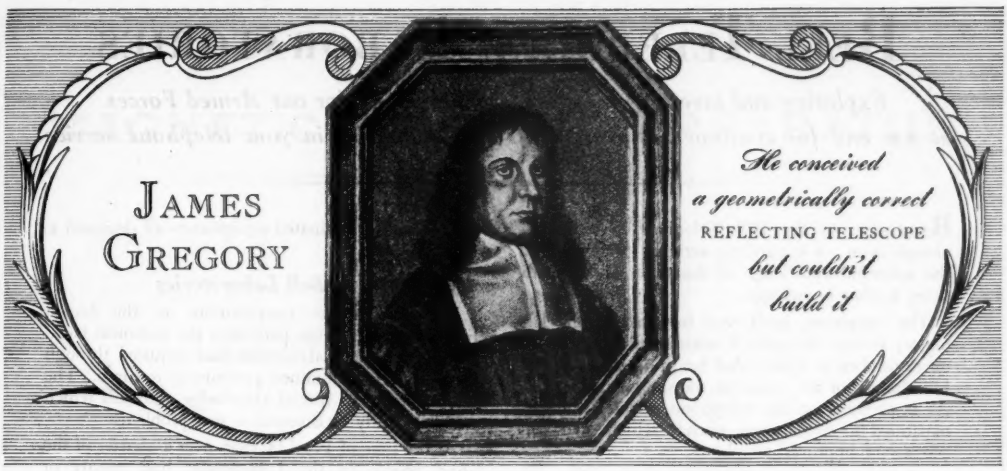

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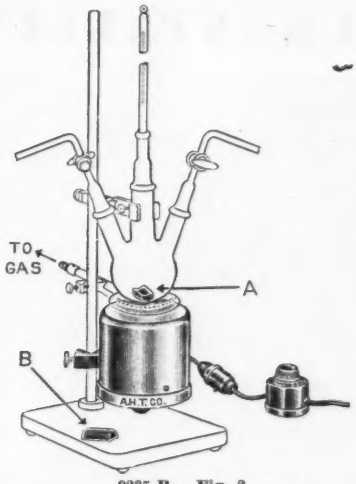

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EDUCATION IN GEOLOGY—HOW ADVANCE IT?[1]

By Professor CHESTER R. LONGWELL

YALE UNIVERSITY

THE title of this address is a complex question calling for a number of answers, and I do not pretend to know all of them. In fact, without some definition of scope the question is too large and vague to furnish a hopeful point of attack in a brief discussion. It may be supposed that any one who has devoted a large share of his life to teaching geology would focus on the mechanics of the college curriculum as the chief matter for attention in a search for means to improve geological education. Undoubtedly improvements can and should be made in that quarter. Our subject has had spectacular recent growth in accumulation of critical factual material, in the development of powerful new techniques and in successful application of principles borrowed from other sciences. As a result our fighting front is far flung, and many parts of it are in a fluid condition. An adequate training program requires frequent adjustments and changes of emphasis to insure proper balance in basic preparation on the one hand, and a high degree of specialized skill on the other.

Important as the college curriculum is, however, I prefer to examine some aspects of our educational program that, in my opinion, are even more fundamental and immediately critical. Attention has been strongly focused on some of these matters by Croneis, in a paper which met a general response indicating that the time is ripe for some concerted study and action.[2] Two facets of the general problem deserve particular thought. Both can be approached through questions that are somewhat more specific than the one in our title. (1) How can a larger number of top-rank students be attracted into geology? (2) How can appreciation of geology be widened and deepened among laymen? Although these two matters seem to

[1] Address of the retiring vice-president for 1943 of Section E—Geology and Geography, American Association for the Advancement of Science, Cleveland, Ohio, September 13, 1944.

[2] Carey Croneis, "Geology in War and Peace," *Bull. Am. Assoc. Petrol. Geol.*, vol. 26, pp. 1221–1249, 1942.

be distinct and to call for separate treatment, probably they are so closely related that to a considerable extent they will be found to merge as expressions of one basic problem.

Whether or not geology is getting its fair share of top-flight recruits may be debated at length without a clear verdict, since several variables are involved and convincing evidence is not easy to produce. Many senior-class records suggest that of college students majoring in science, more of honor-grade are likely to be found in physics and chemistry than in geology. Analyses of graduate-record examinations in the few schools that use this form of test tend to support this general conclusion. Regardless of any dispute on the actual comparative figures, there is considerable question as to what constitutes the "fair share" for geology. Analyses have ordinarily started with the tacit assumption that opportunity is equal among these three fields of natural science. "Intellectual opportunity" is perhaps too intangible for a satisfactory appraisal in this regard. However, economic opportunity, perhaps the most potent single influence, is by no means a constant among the fields. Industry every year recruits a particularly large number of young chemists, and the demand for well-trained physicists is by no means inconsiderable. Possibly the present distribution of the ablest students in science can be explained at least in part on this ground. However, it is not an explanation that geologists can accept with complacency. We also are called on to furnish men for industry and, in addition, to continue the attack on research problems that challenge the best minds. Nothing should be left undone that holds any promise of improving the caliber of the young men who choose geology as their vocation.

One disadvantage suffered by geology in the competition for students lies in the late introduction to the subject that is almost inevitable in the present educational program. Geology is almost strictly a college subject, whereas chemistry, biology and physics are taught, after a fashion, in a large proportion of secondary schools. Only a small percentage of students know what geology is when they enter college. Moreover, a large majority of freshmen take chemistry or physics, along with mathematics, and either postpone geology to a later year or omit it altogether. It is by no means uncommon to hear students who elect elementary geology as seniors express regret that they are unable to pursue the subject further. Few who take the introductory course later than the freshman year elect geology as the major subject—understandably enough, since declaration of the major usually is required before the end of the sophomore year, and the student's natural desire is to make his choice and begin shaping his program as early as possible.

There is no easy escape from the serious difficulty presented by this situation. Curricula of secondary schools already are crowded, and few of us would consider it wise to introduce a full-fledged course in geology at the secondary-school level even if it could be arranged. It is conceivable, however, that certain aspects of the subject may profitably form part of a course in general science in high schools. In some sections of the country an elementary study of minerals and rocks now is included in such courses. There are still some advocates of physiography or physical geography, as a valuable study in high schools, although in general this subject, once widely popular, has fallen into disfavor. It has been revived locally, and I know of one preparatory school in which two teachers, defying the general trend, have maintained a high-grade course that continues to interest a goodly number of students. This school has built up an excellent collection of minerals and rocks, has field excursions as a regular part of the course, and every year turns out boys who enter college with a desire to learn more about geology. It would be interesting to know how many schools in the entire country can approach this record.

Recently I was startled on discovering that even some grade schools present certain aspects of geology in elementary courses of general science. A revelation in one such school raises the question how much misinformation may result from these present efforts. The procedure in the school was to assign a topic to each of several groups of children, who after some days of preparation presented reports illustrated by posters. One group reporting on petroleum had as the most conspicuous poster a large drawing of a dinosaur, which was represented as the source of the all-important fluid! I doubt whether the young researchers actually found this statement anywhere in print. Their mistaken conclusion is a commentary on the power of suggestion. For years the American public has had impressed on its consciousness, by means of billboards, magazine advertisements and labels on oil containers, the image of a dinosaur as the symbol of an oil company. There is no probability that this corporation has had any intention of implanting a monstrous untruth; it merely wants an arresting sign. Nevertheless, the train of thought set going in the mind of the untutored layman is inevitable: Oil got into the ground a long time ago; the dinosaur has long been extinct; great quantities of oil could have come only from the carcasses of huge beasts—that's it, from dinosaurs! Surely the report of the school children does not represent an isolated and chance misconception.

I am not prepared to offer a specific formula for revising pre-college courses of study with a view of serving the best interests of geology. I do suggest that this general subject deserves very serious study by geologists—a study aimed toward some sort of corrective action. We have taken for granted the situation as it exists, accepting the obvious handicap to our training program as if it were fixed by immutable law. Some individuals have seen the problem, but there has been no concerted move even to make a comprehensive study, with the object of learning what the exact situation is, and what changes may be desirable and possible. Even if numerous individual geologists should see a need for action in this matter, how would they proceed? The simple fact is that we are not organized to deal with a far-reaching problem of this kind. We have a number of large and vigorous societies, each of which has developed naturally about a somewhat special focus of interest in the broad field of geologic endeavor. The one with the most comprehensive title—the Geological Society of America—is and has been from its inception a research organization. Its administrative machinery is designed to care for its research program; it is not prepared, nor has it been deputized by the geologic fraternity, to make broad studies leading to policies in education. The American Association of Petroleum Geologists has made some commendable investigations of trends among students in geology and of certain aspects of college curricula. However, it would be altogether inappropriate for the association to assume the heavy responsibility of guiding the entire educational program in geology. We are slowly waking up to a realization that large matters of common interest to all geologists are in danger of going by default, because no existing organization either feels the obligation or has authority to take actions that affect all groups equally. Important societies in earth-science are about as numerous as the original American colonies, and face common problems analogous to those confronting the thirteen political units before they agreed to place their common interests into the hands of a central representative body.

Fortunately there is now under serious consideration the formation of a geological institute or union, to meet the growing need of a central agency to deal with matters of common concern. This need became especially acute under the pressure of problems created by the war; attempts to serve the interests of geology have suffered either from needless duplication among the several organizations or from lack of representatives to act for the entire fraternity on critical occasions. Geologists should make sure, as promptly as possible, that no future emergency shall find us unprepared to act with vigorous and intelligent coordination. There is much more at stake, however, than advance preparation for a possible future war. The situation in geological education constitutes a chronic emergency, which will grow more acute as it is neglected. Other sciences and professions have been more foresighted in this matter. The engineers, for example, have a Society for Promotion of Engineering Education, a progressive and effective organization. Geologists, less numerous and somewhat less heterogeneous than the engineers, do not require a special society to perform this function for their science. However, we might well have an important standing Committee for Promotion of Geological Education. In my opinion, such a committee should be formed and should go to work as soon as the union of geological societies becomes a reality. The committee would give careful attention to all aspects of our educational program. In particular, at an early date it should take up the problem of pre-college training. What is being done, the country over, to give pupils in grade schools and high school some elementary introduction to the subject-matter and the functions of geology? Which of the methods used, in courses that are entitled physiography, physical geography, or general science, seem to be beneficial as elementary preparation for geology or as useful instruction for those who will go no further in this field? What changes, otherwise deemed desirable, appear to be practicable from the viewpoint of the secondary schools? When a blueprint for action is agreed upon by the committee, the weight of the founder societies can be placed behind efforts to put the program into effect. This suggestion is not made with any implication that our plans in this matter, once we have agreed on them, can be carried out with expedition and ease. No doubt the project will involve a long and difficult campaign, with loss of some local battles, revisions of strategy based on hard-won experience, even some changes in objectives as we come to appraise the impact of our efforts on the complex fabric of secondary-school education.

Since the project suggested here is made conditional on formation of the geological union now under consideration, a word concerning this proposed association may be in order. Already a few geologists, with characteristic American distrust of anything savoring of centralization, have voiced fear that a "superorganization" in geology may turn out to be a Frankenstein monster, which will swallow up the autonomy and destroy the cherished independence of the founder societies. It should not be difficult to dispel any such fears. No move is in progress to create a new autonomous unit which will compete with or assume func-

tions of any existing society. There have been some published suggestions—which seem extremely ill-advised—favoring a large new overall organization, in which all interested geologists and laymen might have individual membership, and to which would be entrusted the formulation of policy in all matters of general concern to our science. Even on the assumption that such a new organization would thrive—and there is little probability that it would—surely the consequence would be overlapping and conflict of function, with much more confusion than clarification of our present problems. Progress has been made in developing a more hopeful proposal: that present societies unite in forming an agency—not a governing body—to be manned by representatives from the several participating societies, and to be charged with tasks that concern the interests of all geology and geophysics. Surely one of the prime common interests is the training of replacements for posts of leadership in geologic and geophysical research, teaching, administration, and field application. So vital a matter can not be left any longer to chance or to half-measures if geology is to continue as a virile science. There are additional urgent reasons for close liaison and coordination among organizations in earth-science, as we have come to realize forcibly from experiences during the war. However, even if these other reasons did not exist, the needs of our educational program alone should justify many-fold the cooperative union of societies now in prospect.

The agency planned to coordinate efforts in geology and geophysics looks highly promising "on paper," but an experimental period will be required to test its effectiveness and to repair unforeseen weaknesses in its organizational machinery. During that formative period the founder societies will have to be constantly alert; "eternal vigilance" will be the price of an agency that is to function smoothly and actually meet the major problems for which it is designed. Whatever the theoretical merits of the plan, the personal element will be all-important for successful execution. If the experience of similar coordinating bodies can serve as a basis for forecasting, probably the success of the venture will depend most heavily on finding a wise and devoted executive officer who will guide and stimulate activities of the agency in profitable channels. If the organization can be launched under effective leadership, prospects will be bright for some betterment of our educational situation.

There has been much recent discussion of "public education" in geology, and claims are made that proper attention to enlightening the lay public will provide the key to solution of our outstanding practical problems. Ideas on this subject are so diverse that it is well to make some analysis, in an attempt to determine logical points of departure and sane objectives. On the one hand we are urged, in effect, to throw off our aversion to publicity and to "sell" geology by the most approved commercial methods, with all the eloquence and human appeal of the broadcaster who presents the merits of an oval cake of soap or the "cigar of the hour." The antithesis of this view is the scornful remark of a late dignified gentleman that geology is on too high a plane for the masses, and that attempts to popularize the subject are silly waste of time. Somewhere in the wide area between these extreme viewpoints, some ground for agreement on principle and for practical action may be found. Of course parts of this area have already been explored, and much effective work is being done. The growing tendency to "humanize" scientific knowledge is well expressed in the revised constitution of the American Association for the Advancement of Science, in the statement that a primary object of the organization is "to increase public understanding and appreciation of the importance and promise of the methods of science in human progress."

Probably few students of geology would have any sympathy with the exclusive attitude of the departed gentleman mentioned above. Scientists who stay aloof from programs of popular education usually do so because they are deeply absorbed in their own work, and not from any conviction that popularization is either wrong or futile. Surely a large majority of geologists will agree, at least academically, that many aspects of our subject have inherent popular interest and that a wholesome public-relations program will benefit both the science and the public. There is general agreement also that nearly all geologic literature is not only unattractive but indigestible to the average man in the street. The same statement applies to the literature of any other science, and of course the explanation involves much more than insulating jargon, as any scientist will testify when he undertakes to read a technical treatise on a subject remote from his own special field. The area of general agreement, then, will include the proposition that only selected aspects of geology are suitable for serving to the general public, and that the selected diet should be prepared in somewhat special form. Opinions differ widely regarding the scope and aims of public education and the machinery to be employed. At what segments of the population should our efforts be particularly directed? Should the chief objective be wider recognition and employment of geologic services or merely altruistic extension of geologic knowledge for its own sake? Shall we leave efforts altogether to individual enterprise, or design a sys-

tematic program through national societies and other organizations? If there is to be an organized plan, what part of our total energy and resources can it fairly claim?

From time to time one or another group is brought sharply into focus as an element of the public claiming our interest. In 1928, failure of the St. Francis dam in California directed attention of geologists to public officials and engineers who have charge of building large structures involving bedrock. Probably that disaster established the value of geology in engineering more effectively than years of organized propaganda could have done. During the present war the responsible officers of our armed forces are a part of the public with which we are especially concerned. This is not to say that the Army has ignored geology. Early in the war the Corps of Engineers revealed a well-conceived plan to use geologists for preparing terrain intelligence reports of possible combat areas, and a large civilian organization in Washington has been performing this function with admirable skill and thoroughness. If we had only the accomplishment of this special unit to cite as the contribution of geology to the war effort, the record of our science would be distinguished. The opinion has been widely expressed that this commendable use of geology should have been supplemented by employment of many geologists in the field armies, as there is reason to believe our enemies are doing, to aid in solution of terrain problems as they arise, and to make the terrain intelligence reports prepared in the office more effective by interpretation and constructive modification on the ground. Whatever the merits of this viewpoint, it is probable that geology in its applications to warfare has been employed in the present conflict as fully as this aspect of the science has been clearly defined in the minds of geologists themselves and intelligently presented to military men. If in our view these men have failed to recognize the full potentialities of geology as a basis of military terrain study, a little introspection reveals that geologists gave this important matter only casual and sporadic attention in the interval between the two great wars. We should now profit from this experience; the record of geologic participation in this war should be fully compiled, and the results should be analyzed with the aim of better understanding on the part of geologists as well as military leaders.

Efforts to realize the most effective use of geology in the war have brought conviction that the science will come to be accepted and utilized in special situations in proportion to increase of knowledge and appreciation of its broad concepts among intelligent people everywhere. If this view is correct, our basic problem reduces to fairly simple terms, although its magnitude is undiminished. Even from a long-range viewpoint of self-interest, the most hopeful program of public education in geology looks beyond government officials, military leaders and other important special elements of society. Our goal should be the widest possible dissemination of geologic information that can be made intelligible to laymen without a technical background. Each of us counts among his acquaintances amateurs who have mastered certain aspects of the subject and some who have remarkable grasp of geologic principles. If this comparatively small number were greatly multiplied, public enjoyment of outdoor nature would be increased, geology would have more friends in practical situations, and probably there would be a larger number of worthy candidates for professional study. With these rich returns in prospect, we could justifiably devote a considerable share of our energy and resources to this boundless educational program. There remains the important question of how and by whom the task is to be attempted.

Some have already suggested an answer to this question. They point out that the modern instruments of communication are radio and the printed word. What is required, they say, is an agency to supply talent and funds for regular broadcasts, news stories and magazine articles on geological subjects. It is even suggested that our wealthiest society for research should revise its entire organization and program to become the principal sponsor of this educational experiment. The suggestion might have merit if we could believe that the proposed investment would bring an adequate return. Geologists know, however, that real appreciation of geology is more likely to come from field observation than from clever expositions, either spoken or written. A dweller near the bluffs of the upper Mississippi River may be entertained by well-phrased descriptions and explanations of the Rocky Mountains and the Sierra Nevada, but he will find more genuine pleasure and enduring knowledge by examining the marine strata and the glacial drift in his own neighborhood. Before we experiment by turning a research institution into a chamber of commerce it will be best to explore other and more promising means of geologic instruction. Radio and newspaper publicity are valuable aids in any wide educational movements. However, to rely on these methods as the chief remedies for widespread ignorance of geology would be comparable to the use of an external salve in trying to cure an organic disease.

Every State in the Union has colleges equipped with departments of geology. Many States have also active

Academies of Science which already are giving attention to public education in the sciences, including geology. A number of museums, irregularly distributed, have excellent geologic exhibits and conduct programs designed for laymen interested in geology. Moreover there are numerous local geological societies, especially in States that have large populations of geologists engaged in commercial work. Staffs of these various organizations are not made up of persons of leisure; nevertheless, they are the nuclei of frontline troops that any additional program of public education must call to duty. In many localities they are reinforced by men and women in many vocations, including teachers in secondary and grade schools, who have had training in geology and who continue to follow the subject as a hobby. Opportunities to arouse and foster popular interest are ready made in many communities. Mineral clubs and hiking clubs are numerous and perennial, even in the movie-infested cities. Participation in such organizations by one or more persons who know the local geology often furnishes the spark that turns mild interest into enthusiasm. Possibly the greatest single impetus to the study of local geology is publication of guidebooks that explain the bedrock units and the land forms, and give detailed directions to points of particular interest such as road cuts, quarries, glacial features, mineral localities and the numerous other types of geologic exhibits that nearly every district affords. Obviously some sections of the country offer better material than others for such guidebooks. However, every considerable area has a wealth of geologic features, even though some of the more spectacular types are lacking.

Two obvious comments will be evoked by the foregoing suggestions. First, it will be pointed out that numerous members of teaching departments and of other geological units are already engaged in some of the activities mentioned. This of course is true. I know a number of geologists who are doing yeoman service in popular education by supporting local clubs, giving lectures to amateur groups and making other time-consuming contributions. The success of these individual efforts is the chief basis for encouraging a more extensive program of the same sort. It will be said also, with justification, that mere optimistic talk about large expansion of these local volunteer activities has a "pollyanna" flavor. Large areas in the country have no geological organizations, or at best have only small units with overworked staffs. Preparation of an adequate guidebook is a formidable task, and in many communities there are no resources for publishing such altruistic literature. Schemes for universal missionary work in geological education are impractical unless they make provision for substantial cooperative aid.

Any comprehensive plan must start with an inventory of all effective facilities. A strategic unit is the State Geological Survey. Such surveys exist in a large majority of the States, although they vary between wide limits in size and strength. Some of the more progressive surveys are already showing the way in organized programs of public education. At least one has for this purpose a special division, which supplies mineral study-sets and other geologic materials to schools and amateur clubs, organizes field trips for teachers, furnishes illustrated lectures on request, publishes nontechnical bulletins on the mineral resources and geologic features of the State, and contributes in other ways to a well-integrated educational program. No doubt this and other surveys would cooperate also with local plans of college departments, Academies of Science and local societies, perhaps to the extent of facilitating publication of guidebooks. Integration and mutual stimulation of all agencies within a State would be the ideal arrangement, since the State makes a convenient and manageable unit, and the governmental machinery already developed for educational purposes can be utilized. The Association of College Geology Teachers, a growing organization that has public education as a leading objective, may come to play an important part in State programs.

Geological Surveys vary in strength more or less directly with the value of mineral resources in the States, and a fairly large number of States have either weak Surveys or none at all. Colleges with departments of geology also are few and small in some large sections of the country, and wherever this scarcity coincides with weakness of State Surveys the local facilities for public education are discouragingly small. In these situations the national societies will have to take a hand, if we are to have a nationwide program of public education. This may be another major problem for the geological union, if and when it takes form. Conceivably this body, after appropriate study of the problem, should sponsor a general plan, which would aim to stimulate efforts in public education in all parts of the country. The general principle should be to leave actual operations to local individuals and organizations, and to go no farther than local interest seemed to warrant; to encourage, and in no case to dictate or to supply all facilities. Aid in publication of some local guidebooks might be the chief financial contribution from the societies.

The list of organizations to participate in the close-knit national effort has omitted, up to this point, the U. S. Geological Survey. In general its activities are

subject to budgetary stipulations, and perhaps it could play no leading official part in organizing the proposed educational program. However, many of its members would lend sympathetic support, and no doubt the program would in time receive aid in many forms from the Survey. I am informed that the Survey now has plans for the preparation of abundantly illustrated geologic guidebooks for a number of our transcontinental highways. These will be written in lay language and an attractive style. Comparable guidebooks for the transcontinental and other principal skyways are also being planned, but these would be illustrated primarily with airplane photographs and geologic maps superposed on airplane-photograph mosaics. Modernized railroad guides also are contemplated in this series. The highway guides hold particular promise. In the decade before the war the volume of tourist travel between East and West reached enormous proportions. Prospects are for a large increase of such travel when peace returns. It is true that to some of these tourists the chief objective, at any point on the road, is to reach the next town in the shortest possible time. A large proportion, however, are thoughtful people, curious to know the scientific explanation of natural features along the route. Available road maps guide them to the chief scenic localities, but except for some of the national parks and monuments they find no adequate geologic explanations. Well-designed guidebooks would correct the impression that a few scenic areas in the country are separated by vast spaces devoid of interest. The wide inland seas of Paleozoic date, the glaciers of the Ice Age and other features of the geologic past for which there is abundant roadside evidence, could be made to relieve monotonous modern scenery. Locations of coal fields, oil pools and other mineral deposits, with significant facts of their geologic setting, would be welcome information to many travelers. If only a small fraction of our touring throngs actually used the guidebooks for serious study, the net result would be increased understanding of landscapes in terms of their geologic history and a wider appreciation of geology as a science that is serviceable and not merely entertaining. A large number would use the books to excellent advantage if they were made as informative and attractive as the available subject-matter warrants.

There is increasing evidence that busy geologists are accepting an obligation to contribute time and energy to the large task of interpreting their science to the public. The latest number of the *Geological Magazine* to reach this country contains reviews of three books entitled "Teach Yourself Geology," "Geology for Everyman" and "Geology in the Service of Man." Several books of similar character have appeared in this country within recent years. Unless geologists take the trouble to supply the growing demand for such literature, amateurs will undertake the task, with results that we shall not like. If geologists are to assume the burden, some organization of effort will distribute the load and make the effort far more effective. This suggestion does not point to "regimentation," or any stifling of individual incentive. A project like that of the proposed guidebooks can be accomplished only through coordination of all available facilities—local, State and national.

We ought eventually to have in this country an organization similar to the Geologists' Association in England, designed to serve the common interests of professional and amateur geologists. If such an organization can wax strong on a nationwide scale, it will have a powerful influence in further extension of geological education to the public. Probably growth of an American Geologists' Association will be gradual, perhaps by merging of initial local organizations in parts of the country where amateur interest is particularly strong. Because of the great size of this country, as compared with the compactness of England, no doubt our association of amateurs would operate most effectively in a considerable number of sections, each of which would have an annual field excursion and convention. Basic units would be subdivisions of regional sections, small enough to permit more frequent meetings for field study and discussion. College departments would be active elements in the smaller units, and the entire movement would be a logical development from small beginnings stimulated by local guidebooks in college communities. Any attempt to start such an organization "in reverse," by setting up a national framework before local foundations are laid, would be artificial and probably futile.

At the close of this brief discussion some may feel that Hamlet has been left out of the play, since the large problems of technical training in geology are omitted. No doubt some will see undue emphasis on public education, since the chief function of the geologist is not to entertain the public. However, if we may borrow a phrase from the politician, the "grass-roots" merit our serious attention. Geology has a large asset in the widespread appeal of visible geologic features. Cultivation of this natural interest will be a valuable contribution to cultural education in a materialistic age, and may prove to be the most effective means of insuring a flow of high-grade recruits into our professional ranks. When geologists are ready to give unified and systematic attention to this large and important problem, they will demonstrate that the science in this country is really coming of age.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE ELECTION OF DR. CHARLES FRANKLIN KETTERING AS PRESIDENT

CHARLES FRANKLIN KETTERING was born near Loudonville, Ashland County, Ohio, on August 29, 1876. He is vice-president of the General Motors Corporation and general manager of its Research Laboratories Division. Many and various honors have been bestowed on Kettering, including doctor's degrees from several universities, medals, honorary memberships in technical societies, election to the National Academy of Sciences and the American Philosophical Society, Chevalier, Légion d'Honneur, and the Order of the Crown of Belgium.

He is a director of the National Inventors Council, head of the committee appointed by President Roosevelt to investigate and report on the American patent system, a trustee of Antioch College and supporter of its researches on photosynthesis.

To his co-workers in the laboratories Kettering is referred to as "the Boss," and hosts of his friends affectionately call him Ket. Although best known to the public as an inventor, Ket is most versatile. His achievements in organized industrial research and development have probably been more important to mankind than his personal inventions, even though these include among many the Delco system for the starting and ignition of automotive engines. As occasions demand he becomes a great engineer, a scientist of note, a financier, an industrialist, a public benefactor, a humorist, a lecturer and, by no means least, a philosopher. Many of his homespun philosophical sayings are not only profound but embarrassingly humbling.

In the great industrial upsurge of the past half century led by science and technology, the automotive industry has been one of the main spearheads. In turn, Kettering has been one of the main spearheads of the automotive industry. He has not only been part and parcel of this great forward movement, but as much as any one now living he typifies it.

One way to advance science is to use it. Ket has spent his life using and thus helping to advance science. "Research," he has said, "is an organized method of finding out what you are going to do when you can't keep on doing what you are doing now. . . . Research is a state of mind." The world and science can not keep on doing what they have been doing. Paraphrasing Ket, the future of science and society will be an endless series of states of mind. The American Association for the Advancement of Science should receive great inspiration from his leadership during the coming year.

ZAY JEFFRIES

GENERAL ELECTRIC COMPANY,
CLEVELAND, OHIO

THE EDITING OF SCIENCE

FIFTY years ago, on January 4, 1895, the first issue of SCIENCE, New Series, was published. It was the successor to a journal published from 1883 to 1894 under the same title which had been acquired by Dr. James McKeen Cattell. SCIENCE, New Series, for a number of years had no named editor but appeared under the sponsorship of an "Editorial Committee" consisting of eighteen of the leading American scientists of the day, who together represented all the principal fields of the natural sciences. This editorial committee was continued, with a few changes, for nine years (1895–1903), during which eighteen volumes were printed, consisting of 17,332 pages.

During the succeeding nine years, in which eighteen volumes were also published, the masthead of SCIENCE, except in the last two issues, carried only "Mss. intended for publication and books, etc., intended for review should be sent to the Editor of Science, Garrison-on-Hudson, N. Y." In the last two issues of this period (1904–1912) the words ". . . sent to the Editor of Science . . ." in the masthead were replaced by ". . . sent to Professor J. McKeen Cattell, . . .," a form that was continued until the October 5, 1917, issue, when the earlier instruction that manuscripts be sent to "The Editor of Science" was restored and continued until the last issue of 1921. Beginning with the first issue of SCIENCE in 1922 and continuing until the issue of January 21, 1944, the masthead always carried "Edited by J. McKeen Cattell . . ."

At his death on January 20, 1944, Dr. Cattell had completed forty-nine years and three weeks as editor of SCIENCE. He was not, however, the only editor of SCIENCE during this long period; his wife, Josephine Owen Cattell, was actually, though not formally, co-editor from the beginning, and she and Mr. Jaques Cattell have continued to edit SCIENCE since the death of Dr. Cattell. For fifty years Mrs. Cattell has been largely responsible for editing and writing "Scientific Notes and News" and arranging them for publication. It was she who largely prepared the short articles published under the heading "Scientific Events." There was no part of SCIENCE, not even the advertising,

which was outside the range of her interests and responsibilities.

Dr. Cattell has been praised much and justly for his contributions to American science. A considerable part of that praise should be bestowed upon a talented English woman, Josephine Owen, whom he met as a girl while she was studying music in Leipzig and whom he married in 1888. For more than fifty-five years she was his unfailing helpmate, in the literal and highest sense of the word, and contributed very greatly to the success of his many undertakings.

It is difficult to comprehend the enormous task of editing SCIENCE for fifty years. During all that period its pages have been the same size (about 7½ by 10½ inches, untrimmed), but its type page was increased in length and width beginning with the July 6 issue of 1923. At the same time the type used for the principal articles was reduced from ten-point to nine-point and the spacing between the lines was reduced a little. The pages after these changes carried about 50 per cent. more type than before. In the interval from January, 1895, to the end of June, 1923, the reading text printed in SCIENCE amounted to 50,858 pages, every word of which had been scrutinized in manuscript and also in both galley and page proofs. In the interval from the end of June, 1923, to the end of December, 1944, the reading text in SCIENCE amounted to 26,922 pages, or to more than 40,000 of the type pages used before 1923. Consequently Mrs. Cattell has participated largely in the editing of the equivalent of 90,000 pages of SCIENCE in the original format, or 60,000 of the pages of the size and type now in use.

Readers of journals usually think only of the text as requiring attention and labor. However, advertisements do not appear in journals automatically or without editorial work similar to that given the text. In publishing trustworthy advertisements a journal renders direct service to many of its readers, and indirect service to them because without the revenue received from advertisements scientific journals could be published only at much higher subscription rates or not at all. From the beginning, industries and publishers of the highest standing have used SCIENCE as a medium for reaching those who will be interested in their products. The high standing of SCIENCE as an advertising medium is proved by the fact that twelve companies have advertised in it every year for more than forty years. The Macmillan Company has advertised in SCIENCE every year for the entire fifty years of the existence of the New Series, Henry Holt and Company for forty-nine years, Bausch and Lomb Optical Company for forty-eight years, Gaertner Scientific Corporation for forty-six years, and Fisher Scientific Company-Eimer and Amend for forty-five years.

The foregoing is a sketch of the history of the editing of SCIENCE since it was acquired by Dr. and Mrs. Cattell in 1895, but the Association must also look toward the future. It is widely known to members of the Association that in 1925 Dr. and Mrs. Cattell entered into an agreement with the Association under the terms of which the Association agreed to purchase subscriptions for either SCIENCE or *The Scientific Monthly* for each of its members during the lifetime of Dr. Cattell, and under which SCIENCE would become the property of the Association upon the death of Dr. Cattell, subject to the payment of an annuity to his estate for a period of ten years, the amount of the annuity depending upon the profits from publishing SCIENCE during the preceding five years. Upon the death of Dr. Cattell on January 20, 1944, SCIENCE became the property of the Association. Dr. Cattell wisely wrote into this agreement with the Association the provision that after his death SCIENCE should continue to be edited for three months by The Science Press, the registered name under which Dr. and Mrs. Cattell conducted their publishing enterprises, and as long thereafter as might be consonant with the interests of the Association. After careful consideration, the Executive Committee voted on last May 7 that the Association should take over the editing and publishing of SCIENCE as soon as it should be feasible to do so.

In order to determine the amount of the annuity payable by the Association to Dr. Cattell's estate it is necessary to have the books of account of The Science Press and The Science Press Printing Company audited by certified public accountants for the five years since 1939 to 1943, inclusive. This audit is as necessary in filing returns of the amount of the estate to the State of Pennsylvania for tax purposes as it is for the Association. Consequently, every effort has been made since March, 1944, to get the necessary audit. Conditional promises of audits have been repeatedly made, but the loss of men from the auditing firms to our Armed Forces made it impossible to fulfill them. However, Price, Waterhouse & Co., one of the leading auditing companies in the country, has made a firm commitment to start the audit next April. Although the audits have not been made, it is reasonably certain that the annuity will be somewhat in excess of $20,000 a year, the exact amount depending on the average purchasing value of the dollar year by year relative to that in 1938. Such an annuity is of course a serious matter, but, as the financial reports of the Association for 1944 will show when they shall have been completed and published in SCIENCE, the annuity is not anything to cause apprehension.

In addition to the audit, there are other important matters to consider in order to edit and publish SCIENCE. There are the problems of office space, the securing of office equipment, the employing of competent personnel, all of which have become steadily

more difficult to solve in Washington. In view of all these difficulties the Executive Committee, at a meeting held in Washington on November 14, voted that an agreement be entered into "with Mrs. Josephine Owen Cattell and Mr. Jaques Cattell for editing SCIENCE until December 31, 1945, and that the names of Josephine Owen Cattell and Jaques Cattell shall appear as editors of SCIENCE, and that the editing of SCIENCE shall be under the direction of the Executive Committee during that period." The arrangements are mutually satisfactory and the details are being reduced to written form. The Association, however, has taken over the advertising of SCIENCE, with Mr. Theo. J. Christensen, lately of the Ohio State University Research Foundation, as Advertising Manager; Mr. Christensen is also Advertising Manager of *The Scientific Monthly*.

It follows from these arrangements that contributions for publication in SCIENCE during this year should be sent directly to the Editors of SCIENCE, The Science Press, Lancaster, Pa. Contributions for publication in *The Scientific Monthly* should be sent, as heretofore, to Dr. F. L. Campbell, the Smithsonian Institution Building, Washington 25, D. C., and all communications relative to advertising in either journal should be addressed to Mr. Theo. J. Christensen, Smithsonian Institution Building, Washington 25, D. C.

If by any chance manuscripts offered for publication in SCIENCE should be sent to the Office of the Permanent Secretary they will be promptly forwarded to the editors, for it will be the unvarying policy of the staff of the Office of the Permanent Secretary to give Mrs. Cattell and Mr. Jaques Cattell every possible assistance in their laborious task of editing SCIENCE. The long experience and great success of Mrs. Cattell, sketched above, are conclusive evidence of her competence. May she continue to have health and strength to carry successfully her part of the heavy responsibilities the Association entrusts to her and to her son!

F. R. MOULTON,
Permanent Secretary

OFFICERS FOR 1945

BY mail ballot of the Council, the following officers were elected for the terms indicated, beginning on January 1, 1945.

Officers Elected for One-Year Terms

President: Charles F. Kettering

Vice-Presidents of the Association and Chairmen of the Sections:

Mathematics (A): E. P. Lane, University of Chicago

Physics (B): R. C. Gibbs, Cornell University

Chemistry (C): Henry Eyring, Princeton University

Astronomy (D): J. J. Nassau, Case School of Applied Science

Geology and Geography (E): Arthur Bevan, University of Virginia

Zoological Sciences (F): Carl G. Hartman, University of Illinois

Botanical Sciences (G): F. D. Kern, Pennsylvania State College

Anthropology (H): A. Irving Hallowell, Northwestern University

Psychology (I): Florence L. Goodenough, University of Minnesota

Social and Economic Sciences (K): (No nomination)

History and Philosophy of Science (L): John F. Fulton, Yale University

Engineering (M): George A. Stetson, Editor, *Mechanical Engineering*

Medical Sciences (N): Warfield T. Longcope, the Johns Hopkins University

Agriculture (O): William A. Albrecht, University of Missouri

Education (Q): H. H. Remmers, Purdue University

Officers Elected for Four-Year Terms

Members of the Executive Committee: Anton J. Carlson, University of Chicago; Walter R. Miles, Yale University

Elected Members of the Council: R. E. Buchanan, Iowa State College; Fay-Cooper Cole, University of Chicago

Permanent Secretary: F. R. Moulton

General Secretary: Otis W. Caldwell

Treasurer: W. E. Wrather

Secretaries of Sections:

Mathematics (A): R. W. Brink, University of Minnesota

Physics (B): (No nomination)

Chemistry (C): Neil E. Gordon, Wayne University

Astronomy (D): C. C. Wylie, University of Iowa

Geology and Geography (E): George W. White, Ohio State University

Zoological Sciences (F): J. W. Buchanan, Northwestern University

Botanical Sciences (G): G. W. Martin, University of Iowa

Anthropology (H): Gladys Reichard, Barnard College

Psychology (I): H. E. Burtt, the Ohio State University

Social and Economic Sciences (K): (No nomination)

History and Philosophy of Science (L): Raymond J. Seeger, George Washington University

Engineering (M): Frank D. Carvin, Newark College of Engineering

Medical Sciences (N): Malcolm H. Soule, University of Michigan

Subsection on Dentistry (Nd): Isaac Schour, University of Illinois

Agriculture (O): E. E. DeTurk, University of Illinois
Education (Q): D. A. Worcester, University of Nebraska

Section Committeemen

(Elected by respective Section Committees for four-year terms beginning January 1, 1945.)

Mathematics (A): C. V. Newsom, Oberlin College
Physics (B): F. G. Brickwedde, National Bureau of Standards
Chemistry (C): George Glockler, University of Iowa
Astronomy (D): Otto Struve, Yerkes Observatory, Williams Bay, Wis.
Geology and Geography (E): Kenneth K. Landes, University of Michigan
Zoological Sciences (F): Franz Schrader, Columbia University
Botanical Sciences (G): A. S. Foster, University of California
Anthropology (H): Harry L. Shapiro, American Museum of Natural History, New York
Psychology (I): D. G. Marquis, 2101 Constitution Avenue, Washington, D. C.
Social and Economic Sciences (K): (No election reported)
History and Philosophy of Science (L): Waldemar Kaempffert, *The New York Times*, New York, N. Y.
Engineering (M): Paul L. Hoover, Case School of Applied Science, Cleveland, Ohio (term expires December 31, 1947); Ovid W. Eshbach, Northwestern University (term expires December 31, 1948)
Medical Sciences (N): C. Philip Miller, 5757 Kimbark Avenue, Chicago, Ill.
Agriculture (O): F. D. Keim, University of Nebraska
Education (Q): Gerald S. Craig, Teachers College, Columbia University

OBITUARY

LYSTER HOXIE DEWEY

IN the passing of Lyster Hoxie Dewey, who died on November 27, 1944, at Kenmore, N. Y., at the age of 79, science has lost a widely recognized authority in his chosen field of work, and his former co-workers a beloved friend.

Mr. Dewey was born at Cambridge, Michigan, on March 14, 1865, the son of Francis A. and Harriet (Smith) Dewey. He was educated in the public schools of Michigan, graduating from the high school at Tecumseh in 1885, and from the Michigan Agricultural College (now the Michigan State College) in 1888. For a period of two years he taught botany at the Michigan Agricultural College, and in September, 1890, he was appointed an assistant botanist in the U. S. Department of Agriculture. His earlier work in the department was with grasses and weeds, and from 1899 to the time of his retirement in 1935 he was in charge of investigation and research relating to all fiber plants other than cotton.

Among the various lines of work conducted by Mr. Dewey were his investigations relating to flax and hemp. His selections of fiber flax and hemp resulted in the development of improved strains, and eliminated the necessity of importing seed of fiber flax from Europe, and hemp seed from China. Experimental work with sisal, henequén and other tropical fiber plants was conducted in Puerto Rico in cooperation with the Federal Agricultural Experiment Station at Mayaguez. He visited the Bahama Islands, Cuba and Mexico for the purpose of studying the production of sisal, henequén and other hard fibers in these countries, and in 1911 represented the U. S. Department of Agriculture at the World Fiber Congress held at Sourabaia, Java. During this same year he conducted fiber investigations in Algeria, Ceylon, the Federated Malay States, Japan and the Hawaiian Islands.

During his long period of service Mr. Dewey published numerous circulars, bulletins and articles on grasses, weeds and fiber plants. All of them bore evidence of his unusual background of knowledge of these subjects, and his insistence that each plant be known by its correct name. After his retirement at the age of 70, in 1935, he prepared the section on fiber plants published in "Standardized Plant Names," and also a comprehensive series of articles which were published in Spanish by the Pan American Union in a pamphlet entitled "Fibras Vegetales y su Produccion en America," and by the U. S. Department of Agriculture in Miscellaneous Publication No. 518 entitled "Fiber Production in the Western Hemisphere."

Mr. Dewey during the entire period of his residence in Washington took an active part in the civic and religious activities of the community in which he lived. He was a member of the Petworth Citizens Association and took an active part in the prevention of the sale of alcoholic beverages in the vicinity of schools. He was a member of Gunton-Temple Memorial Presbyterian Church, in Washington, and an elder in that church for forty-two years, including thirty-eight years as Clerk of Sessions. He was also a member of the Botanical Society of Washington, the Biological Society of Washington, the Washington Academy of Sciences, the American Genetic Association, the American Association for the Advancement of Science and the Michigan State Alumni Association.

In 1889, Mr. Dewey married Miss Etta Conkling, with whom he had studied botany in the Tecumseh High School, and she was a most helpful inspiration during all his life. They had two children, Grace Marguerite, who is now Mrs. Carl G. Frost, of Ken-

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more, N. Y., and Mary Genevieve, who died at the age of 17. After a useful life devoted to her family and the service of others, Mrs. Dewey died at her home in Washington in 1938.

Those who were most intimately associated with Lyster Hoxie Dewey found in him an inspiring example. His kindness, modesty, devotion to duty and sterling integrity were ever beyond reproach. His work remains as a monument to an exceptionally useful life, and his memory will be cherished by all who knew him.

HARRY T. EDWARDS

SCIENTIFIC EVENTS

THE MEDICAL HISTORY OF WORLD WAR II

ACCORDING to a report from Colonel Albert G. Love, historian of the Army Medical Department, plans have been made to complete the medical history of World War II six months after victory in the Pacific. Several officers are now assigned to the historical program, approximately half of them serving in overseas theaters. Most of these officers hold graduate degrees in history from leading universities throughout the country. They were commissioned in the Medical Administrative Corps following completion of training in Officer Candidate Schools. They are working on the administrative aspects of the medical service including supply, personnel, training and hospital construction. The professional medical experience of the Army will be recorded by medical officers especially qualified in various specialties.

By this means the history of the Medical Department in the current conflict should be completed within the time limit set by Colonel Love. Previous histories published by the department appeared several years after the cessation of hostilities. Twenty-three years were required to complete the medical history of the Civil War; ten years to complete that of the first World War. Early publication of the current history will be advantageous in that many of the administrative and scientific advances in military medicine will be applicable in planning for national defense and civilian practice. Thus the things which the Army is learning to-day on the world's battlefronts—improved methods of collection and evacuation of the wounded with prompt treatment, better medical and surgical care, the use of new drugs and appliances, control of communicable diseases, advances in reconditioning—will be made public while the knowledge acquired by the Army is still fresh.

At a meeting of historical officers held in the Office of the Surgeon General on December 6, announcement was made that sufficient volumes would be published to cover the entire scope of the professional and administrative work of the department. Material for the series is rapidly accumulating from installations in this country and overseas. Colonel Geo. R. Callender, director of the Army Medical School, stated that excellent reports on missile casualties covering several campaigns have been received for the volume on wound ballistics.

The series gives promise of being the most complete chronicle of military medical advances hitherto compiled. The Surgeon General and other authorities in the War Department are lending their full support.

THE INSTITUTE OF NUTRITION OF THE MICHIGAN STATE COLLEGE

A NEW service organization has been established at the Michigan State College to be known as the Institute of Nutrition. It is planned to coordinate and integrate instruction and research in nutrition and to bring together workers in the field. The program in research and teaching of the college has been broadened to include the production, processing and consumption of food by man and animal.

The institute will supply a contact between industry and the college to further research in food and nutrition and will supply the food industry with results from the laboratory. It in no sense competes with or supplants the research of the Experiment Station, but rather will supplement it through additional funds.

An administrative committee of seven has been appointed. Its members are R. C. Huston, dean of the Graduate School; V. R. Gardner, director of the Agricultural Experiment Station; C. L. Cole, professor of animal husbandry; C. A. Hoppert, professor of biochemistry; Margaret A. Ohlson, head of the department of foods and nutrition; W. L. Mallmann, professor of bacteriology, and C. F. Huffman, professor of dairy nutrition, *chairman*.

The objectives of the institute are outlined by the committee as follows: (1) To better establish Michigan State College as a research center of foods and nutrition; (2) to provide an organization for graduate training in foods and nutrition; and (3) to better serve the consumer, the farmer and the feed and food industries.

The institute will receive aid for its maintenance from the college, and it is hoped that industry, trade associations and agricultural organizations will provide grants for research and industrial fellowships, so that the scope and extent of the work may be materially increased.

THE AMERICAN PHYSICAL SOCIETY

THE two hundred and sixty-fifth meeting of the American Physical Society, which is the "1944 annual meeting," as already announced, will be held at Columbia University, New York City, on January 19 and 20. The American Association of Physics Teachers holds concurrent meetings. The registration desks for the two societies will be in the Pupin Physics Laboratories, where all the sessions will be held, except the session on Saturday morning. The council will meet at 8 P.M. on Thursday in the Men's Faculty Club. The business meeting will be held at 10 A.M. on Saturday.

The retiring address of the president, Professor A. J. Dempster, of the University of Chicago, entitled "Twenty-Five Years of Mass-Spectroscopy," will be delivered after the business meeting and will be followed by the two formal annual events of the American Association of Physics Teachers—the award of the Oersted Medal to a distinguished teacher of physics and the delivery of the fourth Richtmyer Lecture.

At the invitation of the council, a symposium on "The Physics of the Solid State" has been arranged. Six members of the society—S. Dushman, T. A. Read, F. Seitz, W. Shockley, S. Siegel and R. Smoluchowski, will take part. The fourteen papers are distributed among three sessions on the morning and afternoon of Friday and on the afternoon of Saturday. This symposium may be the prelude to the establishment in the society of a Division of the Physics of the Solid State. Time for a discussion of this step has been provided in the schedule of the symposium, beginning at 5 P.M. on Friday.

Sessions for other invited papers and for contributed papers will be held on Friday morning, beginning at 9:30, and in the afternoon.

The dinner of the two societies, advance reservations for which are requested, will be held on Friday evening at six o'clock at the Men's Faculty Club.

COLE PRIZE OF THE AMERICAN MATHEMATICAL SOCIETY

AT the 1944 annual meeting of the American Mathematical Society, which was held in Chicago on November 24 and 25, the Frank Nelson Cole Prize in Algebra was awarded to Dr. Oscar Zariski, professor of mathematics at the Johns Hopkins University, for his "brilliant research in the field of algebraic geometry." The award was made on the basis of the following four papers published during the period 1939–1943:

"Some Results in the Arithmetic Theory of Algebraic Varieties," *American Journal of Mathematics*, Vol. 61, pp. 249–294.

"Algebraic Varieties over Ground Fields of Characteristic Zero," *American Journal of Mathematics*, Vol. 62, pp. 187–221.

"The Reduction of the Singularities of an Algebraic Surface," *Annals of Mathematics*, Vol. 40, pp. 639–689.

"Local Uniformization on Algebraic Varieties," *Annals of Mathematics*, Vol. 41, pp. 852–896.

The Cole Prizes were founded in honor of Professor Frank Nelson Cole, of Columbia University, on the occasion of his retirement as secretary of the American Mathematical Society, and editor of the *Bulletin*. Professor Cole was the secretary of the society for twenty-five years, from 1896–1920. The awards are in algebra and the theory of numbers and are made every five years. The recipient must be a member of the society and not more than fifty years of age at the time of the publication of the memoir for which the prize is awarded. Winners of the Cole Prize in Algebra have been Professors L. E. Dickson and A. A. Albert, both of the University of Chicago.

SCIENTIFIC NOTES AND NEWS

DR. ISAIAH BOWMAN, president of the Johns Hopkins University, has been elected a corresponding member of the Sociedad Chilena de Historia y Geografia.

DR. HARLOW SHAPLEY, director of Harvard College Observatory, has been reelected to the presidency of the Society of the Sigma Xi. Dr. Frank B. Jewett, president of the National Academy of Sciences, has been elected a member of the national executive committee, and Dr. M. C. K. Jones, of the Esso Research Laboratories, Elizabeth, N. J., has become a member of the national membership committee.

THE National Aeronautics Association has awarded the Frank G. Brewer Trophy to Dr. Edgar Fuller, assistant director of the Civil Aeronautics Administration Aviation Education Program in recognition of his work in assisting state governments to develop programs in aviation education, including actual flight training. Special record certificates have been given to Igor Sikorski for helicopter performance and to Colonel C. A. Peterson and Lieutenant Colonel Jack H. Carter, of the Army Air Forces, for west-east transcontinental speed records.

THE Remington Honor Medal was presented to Dr. Harvey Evert Kendig, dean of the School of Pharmacy of Temple University, Philadelphia, at a dinner

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given on December 12 at the annual meeting of the New York Branch of the American Pharmaceutical Association.

A GOLD medal in recognition of distinguished service in the pharmaceutical field commemorating William Proctor, Jr., "Father of American Pharmacy," will be presented to Dr. Ivor Griffith, president of the Philadelphia College of Pharmacy and Science, at a dinner to be held on the evening of January 23 at the Bellevue-Stratford Hotel, Philadelphia.

WILLIAM J. JUDD, in charge of plant propagation at the Arnold Arboretum of Harvard University, has received the Veitch Memorial Gold Medal of the Royal Horticultural Society, London. The Veitch medals are awarded annually to individuals who have made important contributions to the field of horticulture. The two other recipients this year are Colonel S. R. Clark, of Sussex and the Isle of Wight, and Dr. J. Ramsbottom, of the British Museum of Natural History.

A PORTRAIT of Professor J. B. Davidson, head of the department of agricultural engineering at Iowa State College, was presented to the university on November 18. R. H. Driftmier, president of the American Society of Agricultural Engineers, presided, and Dr. R. M. Hughes, president emeritus of Iowa State College, was among the speakers.

PROFESSOR CHARLES A. KRAUS, of Brown University, has been elected a regional director of the American Chemical Society to succeed Professor Arthur J. Hill, of Yale. Dr. Edward R. Weidlein, director of the Mellon Institute for Industrial Research, has been reelected a regional director, and Dr. Willard H. Dow, president of the Dow Chemical Company, has been reelected a director-at-large. The following councilors-at-large have been elected: Dr. Harry L. Fisher, U. S. Industrial Chemicals, Stamford, Conn.; Dr. Donald B. Keyes, director, Office of Production Research and Development of the War Production Board, and chairman of the Chemical Referee Board of the office; Professor Harry B. Weiser, Rice Institute, Houston, Texas; Dr. Robert R. Williams, chemical director, Bell Telephone Laboratories, New York.

THE Mycological Society of America announces the election of the following officers: *President,* Dr. Frank D. Kern, Pennsylvania State College; *Vice-president,* Dr. George B. Cummins, Purdue University; *Secretary-Treasurer,* Dr. F. K. Sparrow, University of Michigan; *Councilors,* Dr. G. W. Martin, University of Iowa, and John A. Stevens, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture.

AT a recent stated meeting of the Eastern Pennsylvania Chapter of the Society of American Bacteriologists, Dr. Earle H. Spaulding, Temple University School of Medicine, and Dr. Harry E. Morton, University of Pennsylvania School of Medicine, were reelected president and secretary-treasurer, respectively.

AT a luncheon meeting of the Louisiana State Chapter of the Society of the Sigma Xi held in the Faculty Club of the university on Thursday, December 14, the following officers for 1945 were elected: *President,* Dr. Max Goodrich (physics); *Vice-president,* Dr. E. C. Tims (botany); *Secretary,* Dr. George H. Mickey (zoology); *Treasurer,* Dr. P. W. West (chemistry); *Members of the Nominating Committee,* Dr. F. B. Kniffen (geology); Dr. S. J. P. Chilton (botany); Dr. M. B. Sturgis (agronomy), and Dr. C. W. Upp (animal industry). The retiring president, Dr. A. R. Choppin, dean of the College of Chemistry and Physics, presided.

DR. HERBERT RUCKES, professor of biology in the College of the City of New York, has been appointed a member of the advisory board of the Watumull Foundation, an organization founded for promoting better relations between institutions in the United States and India.

DR. JAN O. M. BROCK, associate professor of geography at the University of California at Berkeley, has leave of absence to enable him to conduct a study under the auspices of the Coolidge Foundation of the post-war problems of the Southwest Pacific.

DR. WARREN J. MEAD, head of the department of geology of the Massachusetts Institute of Technology, will take charge of the coordination and expansion of research of the Reynolds Metal Company at Winfield Hall, Glen Cove, L. I., formerly the estate of the late Frank W. Woolworth. Associated with him will be Reid B. Gray, formerly chief of the testing laboratories of the Glenn L. Martin Aircraft Company; Dr. Richard J. Lund, until recently mineral consultant of the Office of Production Management, and Dr. Samuel C. Prescott, emeritus professor of biology of the Massachusetts Institute of Technology.

THE Smith Chapter of the Society of the Sigma Xi held its annual fall meeting on November 15, when Dr. C.-E. A. Winslow, director of the Pierce Laboratory of Hygiene of the School of Medicine of Yale University, gave a public lecture on "Science and Planning in the Post-War World." The meeting was preceded by a dinner. The new officers for the coming year are: *President,* Dr. Albert F. Blakeslee; *President-elect,* Dr. Marjorie Williams; *Secretary,* Miss Helen Stobbe, and *Treasurer,* Dr. S. Meryl Rose.

DR. E. M. WEST, associate professor of botany at

the Louisiana State University, has been promoted to a professorship, and Dr. Fred G. Brazda, assistant professor in the School of Medicine, has been made associate professor of biochemistry.

DR. LEWIS B. NELSON, technical agricultural representative with the United States Rubber Company, formerly instructor in the soils department of the University of Wisconsin, has been appointed research assistant professor of soils at the Iowa State College.

DR. GERALD P. COOPER has resigned from his position in the department of zoology of the University of Maine, to join the staff of the Institute for Fisheries Research of the Michigan Department of Conservation at the University of Michigan.

DR. DAVID C. PRINCE, vice-president of the General Electric Company, who has been in charge of application engineering for the apparatus department, has been appointed supervisor of the general engineering laboratory, the activities of which will be broadened to include the requirements for the entire company.

DR. PHILIP LEVINE, formerly associated with the Rockefeller Institute for Medical Research, director of the Biological Division of the Ortho Research Foundation, Linden, N. J., will give on January 11 the first annual Reginald Knight Smith Lecture on "The Rh Factor and Its Clinical Significance." The lecture was established in memory of Dr. Reginald Knight Smith, who served as chief of the Division of Obstetrics of Mount Zion Hospital, New York City, from 1909 to 1937, in recognition of his outstanding medical service to the community.

DR. HERMANN OTTO LAURENZ FISCHER, research professor at the University of Toronto, will deliver on January 18 the fourth Harvey Society Lecture of the current series at the New York Academy of Medicine. He will speak on "Biological and Chemical Relationships between Hexoses and Inositols."

DR. CLYDE E. KEELER, professor of biology at Wesleyan College, Macon, Ga., delivered on December 18 two illustrated lectures on genetics sponsored by the department of zoology of the Louisiana State University. The first, entitled "Researches on Unit Character Genes," was followed by a coffee honoring the speaker. The subject of the evening lecture was "Medical Genetics."

PROFESSOR L. C. DUNN, of Columbia University; Dean Raymond Kirk, of the Polytechnic Institute of Brooklyn, and Dr. Harry Grundfest, national secretary of the American Association of Scientific Workers, on December 15 addressed a forum on "Post-war Policy in Science in the United States" held at Columbia University under the auspices of the New York Branch of the American Association of Scientific Workers.

PROFESSOR E. NEWTON HARVEY, of Princeton University, delivered on December 14 the first lecture of the current session of the Osler Clinical Society, a society of undergraduate students, at the College of Medicine of the University of Vermont. The title of his address was "Decompression Sickness and the Formation of Bubbles in Blood and Tissues."

THE 1945 Winter Technical Meeting of the Institute of Radio Engineers will be held at the Hotel Commodore, New York City, from January 24 to 27. It is requested that reservations be made at once. The annual banquet will be given at 7 P.M. on the evening of January 25, when the address of the retiring president will be made. The president's luncheon honoring Dr. W. L. Everitt will be given at 12:30 on Friday, January 26.

THE Oleson plant collection, which is said to number between fifteen thousand and twenty thousand specimens, has been donated by the Oleson Estate to the Herbarium of Iowa State College. The collection includes algae, lichens, fungi, mosses, ferns and flowering plants. The moss collection is made up of Grout's specimens from Vermont, while the foreign plants include specimens from Ireland, England, Norway, Sweden, Spain, Switzerland, the Sahara Desert, South Africa, Turkey, India, Japan and China.

The Times, London, states "that it can now be made public that an important meteorological station, which has played a vital part in military, naval and air operations against the continent, has been operated by Norwegian forces on the Arctic Norwegian island of Jan Mayen for the past three and a half years. Eight times a day since March, 1941, weather reports from this island, which lies in latitude 71 deg. N., far to the north of Iceland, have been flashed by radio to Britain."

A RECEPTION was held recently at the formal opening of the Society for Visiting Scientists, London, by Professor F. G. Donnan, president of the society, and Sir Malcolm Robertson, M.P. *The Times*, London, writes: "The society has been founded to provide a center of welcome and information for scientists from overseas visiting London. It also arranges meetings for the various groups of oversea scientists at present in this country to enable them to meet British scientists and their own colleagues of other nations. The society's house contains a lounge, restaurant and some dormitory accommodation."

IT is reported in the daily press that the Mineralogical Museum of the University of Liège was destroyed by fire on the day that the city was evacuated by the Germans.

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THE British Secretary of State for the Colonies has appointed a tsetse fly and trypanosomiasis committee to consider and advise on the coordination of action, including research, directed against human and animal trypanosomiasis, and, in particular, against the tsetse fly as the chief vector. The committee, on which the Dominions Office and the Sudan Government are represented, will report from time to time to the Secretary of State for the Colonies, and on all matters affecting research its recommendations will be referred to the Colonial Research Committee for comment and advice before submission to him.

THE name of Professor A. C. Waters, geologist of the U. S. Geological Survey, was accidentally omitted from the article in SCIENCE of August 11, p. 126, giving the names of those who received stars for the first time in the seventh edition of American Men of Science.

DISCUSSION

IMPROBABILITY AND IMPOSSIBILITY

M. LECOMTE DU NOÜY, of the Paris Ecole des Hautes Etudes, in his remarks on this subject[1] has proceeded on the assumption that the evidence which gave the Heisenberg "principle of uncertainty" gave also the quietus to "the old determinism" and rendered the joint determination of the position and the velocity of an electron "a matter of absolute impossibility." But since what is an "absolute impossibility" is evidently determined, M. du Noüy feels at a loss and invites the comments of others.

The "uncertainty" about the behavior of an electron is ours, not necessarily the electron's. If the method for discovering this behavior happens to obscure half of it, that does not signify it to be undetermined. Neither does it signify "absolute impossibility" so far even as the discovery of the obscured portion is concerned. The discovery seems theoretically possible still, like, for example, observation of the other side of the moon.

In order to pronounce anything impossible, on empirical grounds, exhaustiveness of empirical knowledge pertaining to it is required. If we say that is itself impossible, we then presuppose it in the mere assertion. This shows that a judgment of impossibility on empirical grounds involves either a certain omniscience or else self-contradiction.

Now self-contradiction is the criterion of impossibility, on *a priori* grounds—the *a* which is not *a* is impossible. The notion of empirically ascertained impossibility is thus seen to entail the notion of purely logical impossibility. In logic there is an interesting distinction between kinds of implication, namely, the formal, or necessary, and the material; a distinction which powerfully illuminates the import of possible and impossible. Suppose a proposition entails another, as in the composite example: If it is October 13, it is a day of ill luck; then, by necessary implication, it is impossible that it be October 13 and not a day of ill luck, while by material implication it is possible (1) that it is not October 13, yet is a day of ill luck, and (2) that it is not the one and likewise not the other. The reason for (1) and (2) is just that they are contradicted by nothing before, hence are not known to be not the case; which allows the contingency of their being the case. Such contingency is synonymous here with possibility. In general, whatever is not irrational will be considered possible, in thought. This is an indication that possibility is legislated by thought.

Metaphysically the question (possibility) is equally interesting, and it has been a subject for eminent thinkers from before Aristotle to our own day. The solution proposed by Aristotle in his theory of entelechies, and other solutions from different viewpoints by numerous modern philosophers from Leibniz to Whitehead, have rendered the category of possibility into clear terms.

M. du Noüy's question about the color of the emulsion in an unexposed photographic film, and his further question of whether color is determinable in strict objective terms or must be considered subjectively, are questions, no doubt, of epistemological significance. Color might be variously defined, and it is conceivable (hence possible), that some one of the definitions would permit a determination of the emulsion's color, if any, without exposure; likewise that the definition would enable a physicist to tell whether a given substance was colorless. Should M. du Noüy require spectral hues for anything he would call color, and should it be known that the photographic film lacked these, that would be an instance of the colorless. Again, if perception were a requirement of the definition, and were always lacking, the question would be unanswerable. The definition of color is of course not one to be given on logical grounds merely; but since whatever is not illogical is possible, a definition permitting an answer to M. du Noüy's question is within the bounds of possibility.

PETER A. CARMICHAEL
LOUISIANA STATE UNIVERSITY

[1] In SCIENCE for October 13, 1944, p. 334.

PSYCHOLOGICAL DIFFERENCES AS AMONG RACES

PROFESSOR ASHLEY MONTAGU'S recent comments[1] on race differences leaves me with the feeling that I have misunderstood him or failed to understand him.

[1] SCIENCE, n.s., 100: 383–384, 1944.

In the early part of his paper, Professor Montagu quotes from an observation by Professor Strandskov to the effect that if the concept of "races" has any validity, the presence of physiological and "inherent response differences" among such groups would seem to be almost inevitable. Commenting upon this statement, Professor Montagu writes that the results of forty years of psychological testing have failed to reveal differences as among races, whenever these studies have been made by "unprejudiced workers." Apart from the somewhat gratuitous reference to unprejudiced workers, this statement as it stands is certainly misleading and I believe it is definitely incorrect. Psychologists, to be sure, have not always known what their tests were measuring, and some of their methods have not been above reproach. But investigations of race differences in this country have regularly and consistently found differences as between the Negro and white. Such differences are, of course, subject to a variety of interpretations. But the *fact* of their existence can not be denied. I think this distinction between fact and interpretation should be clearly made.

HENRY E. GARRETT
DEPARTMENT OF PSYCHOLOGY,
COLUMBIA UNIVERSITY

THE DISCOVERY OF COELOPLANA ON AMERICAN SHORES

SPECIES of Ctenophores belonging to the Platyctenea, of interest to zoologists by reason of their degenerate structure, creeping habit and possible evolutionary relationship with the Turbellaria, have not previously been reported from the shores of the American continent. During the month of August, however, a Ctenophore belonging to this group was found to exist in considerable numbers at Miami, Fla.

Some unusual marine invertebrates were recently brought to me for identification by Mr. William Sutcliffe, a student at the Marine Laboratory. I was surprised to find that they were a species of Coeloplana, or a closely related genus. They were identified by the flat creeping form, the lack of comb plates and the presence of oral papillae. While moving they reached a length of 8 mm and when fully extended the tentacles measured up to 20 mm. The identification was confirmed by Dr. Libby Hyman, of the American Museum of Natural History.

The specimens upon which identification was based were found crawling in considerable numbers over the surface of algae and hydroids grown in tanks supplied by the laboratory sea water supply. Since their identity and importance became known, Mr. Charles Weiss has informed me that animals answering to their description had previously been observed and photographed by him and that they have frequently been taken from his floating collectors and rafts in the sea water adjacent to the laboratory.

A careful description, based upon more detailed examination, will be published at some future date, and in the meanwhile attention is being paid to the biology and habits of this unusual and interesting animal.

F. G. WALTON SMITH
UNIVERSITY OF MIAMI MARINE LABORATORY,
CORAL GABLES, FLA.

SCIENTIFIC BOOKS

CANCER

The Riddle of Cancer. By CHARLES OBERLING. Translated by W. H. WOGLOM. 196 pages. Yale University Press. 1944. $3.00.

A FEW decades ago cancer research had little to say to the interested public and little to offer to the average investigator, who needs a guiding idea on which to build. Transplantation of tumors had clarified some features of neoplastic growth but confused others, as it is in many respects a mere tissue graft, which, unlike the individual's own cancer, not infrequently regresses. The virus-induced tumors of chickens had no homologues among the mammalian tumors, and even their cancerous nature was doubted. The production of cutaneous tumors by painting the skin with tar merely confirmed human observations. Few suspected that the action of tar was more than that of chronic irritation and that tar contained hydrocarbons which in minute amounts were capable of transforming normal cells into cancer cells; that these hydrocarbons would be synthesized and that their follow-up would bring steroid hormones and bile acids into the orbit of cancer research. Or that the sailor's and farmer's skin cancer was related to exposure to ultra-violet rays, reproducible experimentally at will and the carcinogenic dose expressible in terms of wave-lengths and quantity of irradiation. Or that viruses would be identified in mammalian growth and that their presence might be masked to such an extent that every mammalian tumor would come under suspicion of harboring a virus. Thus cancer research has become an expanding branch of science and of great interest to the general public.

Oberling tells his tale simply and vividly, giving the historical background of cancer research and explaining fully developments in other sciences which have made advancement in cancer research possible.

In tracing the historical development of knowledge of cancer, the tremendous role played by French workers becomes evident. The scientist most often quoted is Borrel, who was among the first to suggest that cancer, including that of the breast, was caused by virus. He adhered to these ideas despite insufficient and often contradictory evidence. No wonder that in a leading review of Oberling's original "Le Problème du Cancer" Borrel is cited in five paragraphs and Peyton Rous is not mentioned, though it was the latter who, with associates, during several decades of systematic research, accumulated a wealth of facts on which the virus theory of cancer rests. These facts will last even if the virus hypothesis should fall. They are duly recognized and related by Oberling, and many of the convincing arguments presented by him in favor of the virus theory are those of Rous and associates.

"The Riddle of Cancer" is as informative as it is interesting. Research workers in the field of cancer will often find their opinion questioned or contradicted; nevertheless, they will be stimulated by this book. The correctness of some of the entertaining stories "behind the curtain" is difficult to ascertain. Hanau, the first to transmit a tumor, is stated to have found his work shamefully neglected and in umbrage destroyed himself. Hanau had carcinoma of the large intestine, which recurred after two operations[1]; this does in part explain his suicide at the age of 41. Eloquence and wit are often coupled with overstatements, *e.g.*, that transplantable tumors are incapable of furnishing information applicable to man. From the time of the brilliant paper of Hanau up to the current papers of Greene on heterotransplantation of tumors, experimentation with transplantable tumors has contributed much to the understanding of the phenomena of cancer. Since tumors arising and transplanted in the homozygous stocks behave almost like the animals' own tumors, they may be found useful in types of experiments where heterozygous mice can not be employed. Investigators must, of course, be familiar with the limitations and pitfalls of working with transplantable tumors.

The hypotheses concerning the immediate cause of cancer are well reviewed, and the conclusion is reached by Oberling that only the virus hypothesis is compatible with all known observations. According to him, the great virtue of the mutation hypothesis is that it leaves the way open for any etiological conception; its great fault, that it explains nothing. Is it not a good explanation of autonomy, the most important feature of a neoplastic cell? Among the other objections to the somatic mutation theory of cancer are that somatic mutations are rare in mammals and the few that are known invariably effect secondary changes like pigmentation; they are never associated with such a radical change as malignant transformation of cells. These are hardly convincing arguments. The strongest point against the somatic mutation hypothesis is the observation that often the development of cancer appears to be a step-by-step change. In the opinion of Oberling, "Alone among the various hypotheses, that of the viruses seems to have a real chance of leading to the goal." Observations in support of the virus hypothesis are well reviewed, whereas those against its acceptance are minimized. Among these is the individuality of each cancer, which in terms of the virus theory would require a distinct virus for each tumor in each individual.

The French edition appeared in 1942. The Jane Coffin Childs Memorial Fund made this work available to the English-speaking world by entrusting its translation, nay, its recast, to no less a craftsman than William H. Woglom. The reader may miss the charm of the French original, but Woglom has accomplished what is seldom done, the pouring from one golden goblet into no baser a metal.

JACOB FURTH

[1] "Ein bewegtes Gelehrtenleben." By Otto Lubarsch, Berlin, 1931.

PERUVIAN ARCHEOLOGY

Peruvian Archeology in 1942. By A. L. KROBER. Viking Fund Publications in Anthropology, Number Four. 151 pp. 48 plates. 8 text figures. New York: The Viking Press. 1944.

DR. KROBER visited Peru in March and April of 1942, journeying from Lima southward to Arequipa and northward to Lambayeque. His book, however, covers a much larger scope, for it deals with all the outstanding problems of Peruvian archeology and with the current ideas of the leading field workers. In 1925 and 1926, the author had conducted excavations in both northern and southern Peru, on which and on museum collections he based various detailed studies. These were partly prepared in collaboration with Drs. Gayton, O'Neil and Strong; they were published by the University of California and Field Museum. His present work not only continues previous studies but is a résumé of the current state of Peruvian archeology.

Dr. Krober points out that some sixty cultural phases are now recognized in Peru. Of these, he has assembled fifty in a chronological tabulation, which presents the cultural sequences as they are now known in eight different areas. The author remarks that such diagrams tend to crystallize into dogma, but they are extremely useful to the non-specialist and specialist alike.

About half of the sixty cultural phases, it is inter-

esting to note, have been discovered or distinguished since 1910. Dr. Krober comments that "the doubling of archeological operative categories in one working life-time is a sign of the healthy growth of Peruvian archeology."

While much of the text necessarily is technical and detailed, major problems are also discussed. Perhaps the most important recent change in regard to Peruvian pre-history is that Uhle's concept of an early and primitive fishing population is no longer accepted. This culture, represented by massive incised pottery from Ancón and Supe, has been known for many years. Similar pottery, with regional variations, is now known at many other sites both on the coast and in the mountains, including the famous ruins at Chavín. Archeologists, by demonstrating the distribution and period of this culture, have a new and valuable tool for determining cultural sequence in northern Peru, comparable to the widespread Tiahuanaco and Inca cultures.

Dr. Krober has written a clear analysis of the famous Paracas culture, which he divides into two major chronological periods. These he places immediately before and after early aspects of Nasca art. He has also discussed in detail the stone carvings of Chavín and Sechín, which have been described by Drs. Bennett and Tallo in recent publications.

In regard to absolute dates of prehistoric culture in Peru, Dr. Krober is cautious in view of the lack of specific evidence. For some years it has been customary to ascribe early cultures to the early centuries of the Christian era. The author writes, "My only feeling is that many of the suggested dates have been put needlessly far back, which of course is always more impressive." The reviewer voices his agreement with this statement, especially in the light of material unearthed in Peru in 1943 and 1944. Similar downward revisions of time estimates have been necessary in regions where knowledge of absolute chronology has made great advances, such as the southwestern United States and the Maya area.

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SPECIAL ARTICLES

THE DEGRADATION OF CYSTINE PEPTIDES BY TISSUES[1]

SEVERAL years ago Bergmann, *et al.*, suggested that amino acids might be enzymatically degraded while they are yet in peptide combination, yielding by an $\alpha\beta$ dehydrogenation the corresponding "dehydropeptide,"[2] Several types of dehydropeptides were synthesized, and with the discovery that extracts of swine kidney could effect the hydrolysis of such peptides the possibility that the latter were indeed biological intermediates seemed valid.[3] The enzyme responsible for this hydrolysis was named dehydropeptidase, and it was shown to be distinct from those peptidases which act upon the peptides of the naturally occurring, saturated amino acids, *i.e.*, aminopeptidase, carboxypeptidase, etc. The significant products yielded by the action of dehydropeptidase were ammonia and the corresponding α keto acid, both derived from the dehydrogenated amino-acid moiety.[3]

The concept that amino acids in peptide combination could be enzymatically attacked was a bold and discerning stroke on Bergmann's part, for it suggested that the catabolism of proteins could begin at the polypeptide stage. Bergmann did not commit himself on what the possible natural precursors of the dehydropeptides could be. We suggest that the peptides of cystine (or cysteine) serve in this capacity, yielding by desulfuration the corresponding dehydropeptide, and our evidence follows.[4]

There is present in certain mammalian tissues an enzyme which rapidly degrades cystine (aerobically or anaerobically) to pyruvic acid, ammonia and hydrogen sulfide.[5] We have found that certain peptides of cystine were degraded to the same products under similar conditions.[6] New data on such peptides, their derivatives and related substances digested with rat liver extracts are given in Table 1. The data reveal (1) that the cystine moiety of the vulnerable peptides must have either a free amino or a free carboxyl group (thus be exopeptides), since glutathione and the diketopiperazines are not attacked; (2) that the sulfur atom in an otherwise available substrate must be free since S-benzylcysteine is not attacked; (3) that the ammonia and pyruvic acid found in digests of the vulnerable peptides such as dichloracetylcystine must have been evolved from the cystine moiety subsequent to the rupture of the peptide bond; (4) that cystine

[1] Our interest in the cystine-degrading system arose from the fact that although it is found in certain normal tissues, it is the only intracellular enzyme that we have encountered which appears to be completely absent in every kind of cancerous tissue studied, *c.f.*, J. P. Greenstein, Gibson Island Conference on Cancer, 1944.

[2] M. Bergmann, V. Schmitt and A. Miekeley, *Zeits. physiol. Chem.*, 187: 264, 1930; M. Bergmann and K. Grafe, *Zeits. physiol. Chem.*, 187: 187, 1930.

[3] M. Bergmann and H. Schleich, *Zeits. physiol. Chem.*, 205: 65, 1932 and 207: 235, 1932.

[4] J. P. Greenstein and F. M. Leuthardt, *Jour. Nat. Cancer Inst.*, 5: no. 3, 1944 (in press). Cystine and cysteine, free or in peptide form, yield identical products, and to avoid repetition we shall use only the former term.

[5] C. V. Smythe, *Jour. Biol. Chem.*, 142: 387, 1942.

[6] J. P. Greenstein, *Jour. Nat. Cancer Inst.*, 3: 491, 1943.

TABLE 1

AMMONIA AND PYRUVIC ACID DERIVED FROM VARIOUS SUBSTRATES IN RAT LIVER DIGESTS*

Substrate†	Ammonia N	Pyruvic acid
	mols × 10^6	mols × 10^6
Cystine‡	11	6
Cysteine‡	7	7
S-Benzylcysteine	0	0
Cystinyldiglycine‡	10	3
Cystinyldidiglycine‡	11	4
Diglycylcystine‡	12	6
Dichloracetylcystine‡	10	6
Cystinylcystine‡	12	5
Cysteinylcysteine‡	6	4
Bisanhydrocystinylcystine	0	0
Anhydrocysteinylcysteine	0	0
Glutathione (oxidized or reduced)	0	0
Alanylglycine	0	0
Glycylalanine	0	0
Chloracetylalanine	0	0
Chloracetyldehydroalanine	19	16
Glycyldehydroalanine	21	19

* Mixtures incubated for 2 hours at 37° C consisted of 2 cc rat liver extract equivalent to 600 mgms of tissue plus 1 cc phosphate buffer at pH 7.0 plus 1 cc substrate solution at 25×10^{-3} mols concentration. Blanks subtracted from test readings. Concentration of sulfur-containing compounds was 25×10^{-6} mols S.

† Description of substrates, etc., given in footnote 4.

‡ H_2S present.

and its peptides are degraded to a nearly equal extent in the same time interval,[4] and (5) that related peptides such as alanylglycine, glycylalanine and chloracetylalanine are not degraded under these conditions.

The products found in digests of the exocystine peptides are certainly derived subsequent to the hydrolysis of the peptide bond. If it is assumed that these peptidases, using alanylglycine, triglycine and latter degraded as usual, a puzzling dilemma arises. To hydrolyze these peptides at the rate required, the presence of an active aminopeptidase for such substrates as cystinyldiglycine, cystinyldidiglycine and diglycylcystine, and the presence of a correspondingly active carboxypeptidase for dichloracetylcystine, would be expected. When however the same liver extracts were tested by the usual titrametric procedures for these peptidases, using alanylglycine, triglycine and chloracetyltyrosine as substrates, no activity at all could be noted within the two-hour incubation period. Adherence to the idea that the cystine peptides, as such, are hydrolyzed would demand the presence in liver of an aminopeptidase and a carboxypeptidase inactive toward the classical substrates for these enzymes, and specific for cystine peptides. While this possibility can not be arbitrarily denied, we have preferred to suggest another mechanism.

It is proposed that the exocystine peptides are (I) first desulfurated to yield the corresponding αβ unsaturated dehydropeptide (peptide of dehydroalanine) plus hydrogen sulfide and sulfur, followed by (II) the hydrolysis of the dehydropeptide to the principal products of pyruvic acid and ammonia. Using dichloracetylcystine as the type for all susceptible cystine peptides, the reactions may be formulated as follows:

(I). $[ClCH_2CONHCH(COOH)CH_2S-]_2$
Dichloracetylcystine
$\rightarrow 2[ClCH_2CONHC(COOH)=CH_2] + H_2S + S$
Chloracetyldehydroalanine

(II.) $[ClCH_2CONHC(COOH)=CH_2]$
$\xrightarrow{H_2O} ClCH_2COOH + NH_3 + CH_3COCOOH$

This concept is based upon the following lines of evidence: (a) the failure of S-benzylcysteine to be degraded suggests the precedence of the desulfuration reaction; (b) by the use of chloracetyl- and glycyldehydroalanine as substrates we have observed the presence of a powerful dehydropeptidase in liver (and in other tissues) which degrades both substrates equally to pyruvic acid and ammonia (Table 1); (c) we have observed that extracts of liver, kidney and pancreas (from rats, mice, rabbits and guinea pigs) which degrade cystine peptides to the products noted also degrade dehydropeptides to the same products (except sulfur, naturally); whereas extracts of spleen, brain and muscle, as well as all types of cancerous tissues, from these species, degrade neither kind of substrate, and (d) the observation by Bergmann and Schleich[5] that glycyldehydrophenylalanylglycine was not degraded by dehydropeptidase indicates that for enzymatic susceptibility both cystine peptides and dehydropeptides must possess an exo-configuration. In extracts of liver, kidney and pancreas, the rate at which the dehydropeptides were hydrolyzed was in every case much greater than that at which the cystine peptides were degraded to the same products, suggesting that the desulfuration reaction (I) is the rate-limiting process in the degradation of the latter substrates. Dialysis of liver extracts for twenty-four hours against either running tap or distilled water results in the complete loss in such extracts of the capacity to degrade the cystine peptides, although the capacity to hydrolyze the dehydropeptides is completely retained. This indicates that the systems responsible for reactions I and II are separate entities. As far as we have gone, it would appear that the capacity to degrade cystine peptides to ammonia and pyruvic acid and the capacity to degrade dehydropeptides derivable from these cystine peptides to the same products either occur together in the same tissue, or, in another kind of tissue, do not occur at all. Digests of active tissues with susceptible cystine peptides do not stop short at reaction I with desulfuration, but in every case where hydrogen sulfide appears in the digests so also do ammonia and pyruvic acid.

Our findings may be considered to support Bergmann's original concept of peptide dehydrogenation; we have simply suggested the possible mechanism whereby this metabolic step may be effected.[7] Because

[7] The interesting observations by B. H. Nicolet, L. A. Shinn and L. J. Saidel (*Jour. Biol. Chem.*, 142: 609, 1942), that treatment of silk with alkali leads to the formation of dehydroalanine at positions in the peptide chain formerly occupied by serine, raises the question as

of the structural requirements of the cystine peptide substrates, it is suggested that the enzyme responsible for reaction I be designated "exocystine desulfurase." It may be that the exocystine desulfurase-dehydropeptidase system is involved in a detoxification mechanism. Free cystine in excess is known to produce hepatic and renal damage.[8] Peptides of cystine are more soluble than the free amino acid, and it may be advantageous for the tissues to destroy the cystine while it is in susceptible peptide form before it can accumulate to the free, largely insoluble and certainly toxic amino acid.[9]

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THE DIFFUSION CONSTANT OF PENICILLIN

USING the sintered glass membrane technique, the diffusion constant of penicillin has been measured over the pH range 4.0–8.0. To minimize errors due to the decomposition of the active material, the experiments were conducted at 0.5° C. Preliminary experiments indicated that at low temperatures the rate of decomposition of penicillin was not significantly affected by concentration at pH 7; this fact has been verified for the entire pH range covered.

The diffusion cells were similar to those described by Mouquin and Cathcart.[1] They were calibrated with 2.0M sodium chloride solutions, the value 1.27 cm² per day being taken for the diffusion constant of this substance at 25.0°.[2] Lederle penicillin (sodium salt, potency 250–300 Oxford units per mg) was employed. At pH 4.0 and 5.0, Na_2HPO_4-citric acid buffer was the solvent; for the other experiments KH_2PO_4-Na_2HPO_4 mixtures were used. The diffusion constants were calculated by means of the equation:

$$D = \frac{V_2 C_2}{tKC_1}$$

where V_2 is the volume of the cell compartment into which diffusion occurs, K is the cell constant, and C_2 and C_1 are the penicillin concentrations on the "low" and "high" sides of the membrane, respectively, at the end of time t. For experiments of short duration ($C_2 < 0.02\ C_1$) this calculation gives results nearly identical with those obtained using the more elaborate expression derived from the integration of Fick's first law.

Penicillin concentrations were estimated by a turbidimetric microbiological assay procedure, using *Staphylococcus aureus* as the test organism. This method will be described in detail in a subsequent publication.

The experimental results are summarized in Table 1. Included are the values of C_1; essentially, this figure represents the concentration difference across the membrane throughout the run. Each value for D presented is the average of at least two determinations made with different cells. The average deviation was about 2 per cent.

TABLE 1

pH	C_1 (Oxford units per ml.)	$D_{0.5°}$ (Cm^2 per day)
4.0	50	0.192
5.0	59	0.165
6.0	46	0.180
7.0	45	0.176
8.0	38	0.178
7.0	608	0.165

The change in D observed as the pH is decreased is probably a reflection of the conversion of the salt to the acid form. Abraham and Chain[3] have reported that penicillin appears to be a dibasic acid, characterized by "titration constants" of 2.43 and 3.5.

The last value in Table 1 is the result of an experiment performed to observe the effect of concentration upon the diffusion constant. The significance of this datum as compared with the corresponding one at lower concentration is uncertain.

Friedman and Carpenter[4] have demonstrated that the Stokes-Einstein equation (relating D to molecular radius) is valid for molecules as small as the hexoses. Applying this equation to the data at pH 7 results in the value 5.37 Å for the radius of the penicillin molecule. Assuming the density to be 1.25, the calculated molecular weight is 490. This figure is consistent with the value 510 suggested by Abraham and Chain.[3]

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to whether dehydropeptides might not also be derived under natural conditions from peptides of serine. This possibility must be borne in mind, although there is as yet no enzymatic evidence relating to the possible degradation of serine peptides. We have confirmed Smythe's findings that free serine, unlike free cystine, is not enzymatically attacked in rat liver extracts.[5]

[8] A. C. Curtis and L. H. Newburgh, *Arch. Int. Med.*, 39: 828, 1927; D. P. Earle and J. Victor, *Jour. Exp. Med.*, 73: 161, 1941; P. György and H. Goldblatt, *Jour. Exp. Med.*, 75: 355, 1942.

[9] Since this communication was submitted for publication, Dr. Max Bergmann died, untimely, at the height of his productivity and usefulness. It is my hope that this brief note may serve, even if inadequately, as a tribute to the memory of a man who was a great chemist, an unassuming personality and a warmhearted friend.—J.P.G.

[1] H. Mouquin and W. H. Cathcart, *Jour. Amer. Chem. Soc.*, 57: 1791, 1935.

[2] M. L. Anson and J. H. Northrop, *Jour. Gen. Physiol.*, 20: 575, 1937.

[3] E. P. Abraham and E. Chain, *Brit. Jour. Exp. Path.*, 23: 103, 1942.

[4] L. Friedman and P. G. Carpenter, *Jour. Am. Chem. Soc.*, 61: 1745, 1939.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

LYOPHILIZATION APPARATUS

THE accompanying diagram (Fig. 1) illustrates a simple, rugged, inexpensive lyophilization apparatus which has been used successfully for moderately large-scale laboratory work.

Approximately 50 pounds of dry ice, broken into small lumps by means of an ice chopper, are required to fill the insulated chamber. Effective cooling is thus maintained without organic solvents and without further attention for at least 24 hours of operation. For shorter periods of lyophilization, the dry-ice requirement can be reduced by a false bottom in the dry-ice chamber.

The cylindrical welded steel receiver is unbreakable and has a condensing capacity of approximately 6 liters. The manifold is constructed of pyrex glass and is connected to the receiver by means of a rubber stopper. Obviously, the design of the manifold and the number of outlets can be varied to suit individual requirements. A useful design consists of four outlets spaced at 90° intervals to which round bottom pyrex-glass flasks of 1- or 2-liters capacity can be attached either by ground-glass joints or rubber stoppers. The flasks are filled to about one third of their

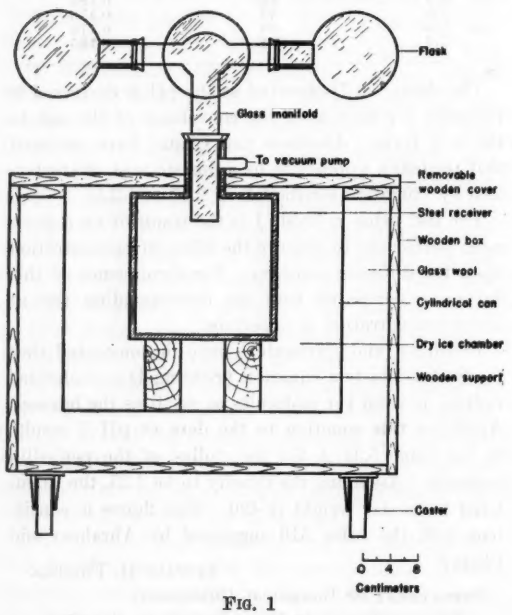

FIG. 1

capacity, and before they are attached to the manifold, are rotated in a dry-ice-solvent mixture to freeze the material in a thin layer.

A pressure of approximately 0.2 mm can be attained rapidly and maintained by means of a mechanical high-vacuum pump of suitable capacity. Approximately 1,200 ml of water (300 ml in each of 4 one-liter flasks) can be removed in 20 to 24 hours.

As suggested by Campbell and Pressman[1] a piece of cotton gauze cemented over the manifold opening effectively prevents loss of small amounts of dry material during lyophilization. Small leaks which may develop in the rubber or ground-glass joints when the system is subjected to high vacuum can be prevented by the liberal application of a sealing compound such as Apiezon Sealing Compound Q.[2] A sealing compound of this type, which is plastic at room temperature, can be applied quickly and easily and can be stripped off and reused. Furthermore, sealing connections from the outside in this manner obviates the use of greases, which may contaminate the material during lyophilization or during removal of the dry material from the flasks.

The usefulness of the apparatus can be increased by providing the cabinet with casters so that it may be moved as required. The vacuum pump, pressure gauge and a cold trap for protecting the pump can also be mounted on a caster-equipped table so that it can be used either with the lyophilization apparatus or with other equipment.

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NEW ORLEANS, LA.

[1] D. H. Campbell and D. Pressman, SCIENCE, 99: 285, 1944.
[2] May be obtained from the James G. Biddle Company, Philadelphia.
[3] On military leave.
[4] This is one of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

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SCIENCE NEWS

Science Service, Washington, D. C.

TOTAL WAR AGAINST INSECT PESTS

TOTAL war against man's insect enemies, with the avowed object of total extermination instead of mere "control," was offered as a possible and practicable program before the New York meeting of the American Association of Economic Entomologists, in the address of its retiring president, Professor E. O. Essig, of the University of California. Man has unintentionally wiped out a number of animal species, like the dodo and the passenger pigeon; there seems to be no good reason why he should not be able to repeat the performance intentionally with other species he finds obnoxious, if he will only plan carefully enough and follow through with sufficiently long and intensive campaigns of eradication.

Success in at least one such campaign was cited by Professor Essig. About twenty years ago the Mediterranean fruit fly, a terrible menace to certain fruit and vegetable crops, especially the citrus fruits, was accidentally introduced into Florida. Drastic measures were necessary, but by thorough cooperation among federal, state and private interests the last traces of the fly infestation were wiped out in a short time.

Similar success appears to be in sight in campaigns now being waged against other insect pests. Among these, Professor Essig mentioned the Mexican fruit fly, pink bollworm and sweet-potato weevil in the South, and the pear psylla in the Pacific Northwest. Prospective victims suggested by the speaker for future anti-insect blitzes include Japanese beetle, gypsy moth, browntail moth, all kinds of malaria mosquitoes, bedbugs, lice, fleas and houseflies.

A powerful agent in these postwar wars to make crops less costly and personal life safer and more comfortable is the now known DDT. At the meeting, the first official pronouncement of organized entomological science on this insecticide was offered, in the form of a special committee report.

DDT has tremendous possibilities, the report emphasized; but there are also some difficulties attending its use that need further investigation without loss of time. For this reason, adequate funds and personnel for research were pointed out as desirable, together with the assignment of sufficient quantities of DDT for experimental purposes.

DDT's promise spreads broadly over three fields: public health, household comfort and agriculture. In the first category come the triumphs already scored by DDT against such plagues as malaria and typhus. Household comfort will be promoted by the abatement or even the complete wiping out of such insects as flies, fleas, bedbugs and "nuisance" mosquitoes. DDT can be useful to agriculture not only in combating field and orchard insects, but also in protecting forests, livestock and poultry.

DDT is poisonous to man and the warm-blooded animals generally if swallowed in sufficient quantity, or absorbed through oil on the skin. However, as commonly used at present, there seems to be an adequate margin of safety. Cold-blooded animals, like fish and frogs, and beneficial insects are more sensitive; their protection was cited as one of the desirable objectives of research.

ITEMS

SOVIET blood will soon be prepared for fighting shock in Russian wounded through use of four complete plasma processing units given to the U.S.S.R. Red Cross and Red Crescent Societies by the American counterpart of this organization, the American Red Cross. Professor Peter G. Strelkov, of the U.S.S.R. Academy of Sciences, flew to this country to arrange for its use in Russia, and Captain John Reichel, Jr., of the Office of the Surgeon General of the U. S. Army, will accompany the apparatus to Russia to aid in its installation and use. Professor Vladimir Lebedenko, Washington representative of the Soviet Red Cross, in receiving the apparatus in presentation ceremonies stated that the 4,000 pints of blood daily that will be processed by the four units will supply the Russian armies and civilians in reoccupied areas as well. The equipment was paid for from war relief funds given the Red Cross by Congress.

THAT the post-war personal airplane may become as easy to fly as it is to tune a push-button radio, is predicted by Oliver L. Parks, president of Parks Air College, at East St. Louis, Ill. Progress in the design and development of airplanes and electronic devices will make this easy flying possible. In the future it is entirely possible that a pilot will be able to take his plane off the ground, bring it to the desired altitude, set its nose in the proper direction, and by push-button controls, tune it into a beam directed at the city of destination. With the aid of an automatic pilot the plane would fly on the beam. Such a device would not have to be expensive, according to Mr. Parks, since the price of automatic pilot devices has gone down by several hundred per cent. during the war.

GAS turbines in railroad locomotives may be widely used in the future. Investigations show that they have sufficient natural advantages to assure them a place of recognition for such use, was reported by J. T. Rettaliata, of the Allis-Chalmers Manufacturing Company, at the New York meeting of the American Society of Mechanical Engineers. The speaker gave details of a 4,800 horsepower electric-drive locomotive, powered by two gas-turbine units. Its top speed when hauling 15 cars weighing 1,000 tons is 95 miles per hour on a tangent level track. Its maximum speed with a single engine in operation, he said, would be approximately 70 miles per hour. Operation of the locomotive is economical. "The absence of water in the cycle is a natural advantage for railroad service. The low maintenance record associated with the oil refinery gas-turbines of similar design encourages the present contemplation that the service charges on locomotive units will be correspondingly moderate. As is characteristic with all equipment of the turbine type, lubrication costs should be exceedingly small; it is estimated that they will be less than one per cent. of the fuel costs."

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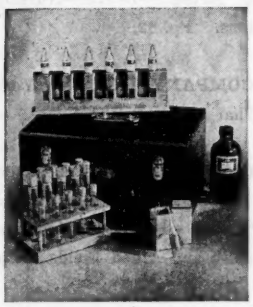

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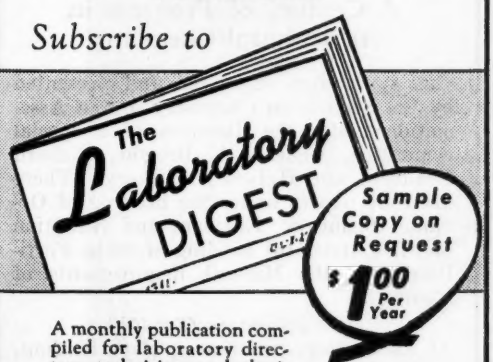

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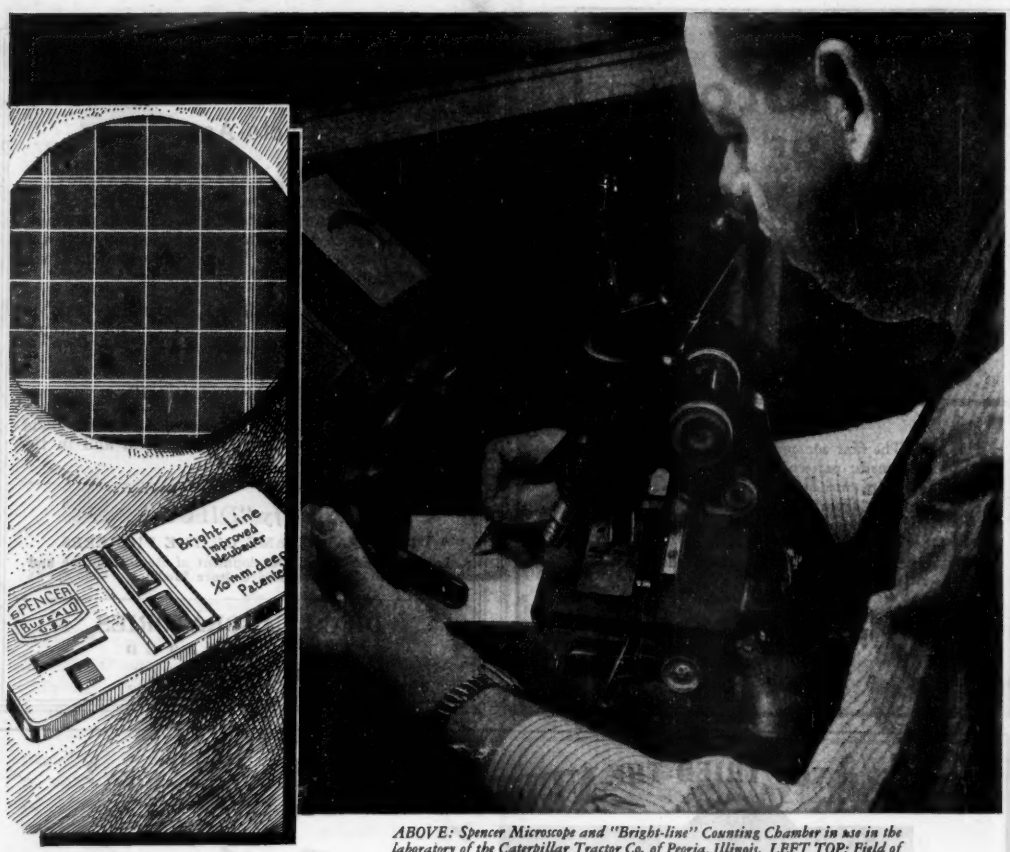

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